AECD - 2694

UNITED STATES ATOMIC ENERGY COMMISSION

IMPROVED HOT-WIRE VACUUM SWITCH

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Date of Manuscript: September 6, 1945
Date Declassified: August 25, 1949

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Technical Information Division, ORE, Oak Ridge, Tennessee
AEC, Oak Ridge, Tenn., 2-23-50--850-A9333

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By Clarence Wieske

The purpose of this report is to summarize the changes and improvements made on the hot-wire vacuum switch since the original report, Vacuum Special No. 15.

The first panel (Schematic Drawing 1W 1332) provided only a source of constant current for the switch, with a method for adjusting that current to change the cutoff point. It also provided a relay shunted across the hot wire to provide an alarm in case of a wire breakage. This was necessary because if the wire broke, there would be no way of knowing that the vacuum protection was inoperative.

In actual operation on installations a number of difficulties were met. They were overcome in the improved panel (Schematic Drawing 1V 5172E and photographs Electric 665 and Electric 664) in the following manner: Difficulty with Geissler discharge and arc-over to ground, at favorable pressure conditions, was overcome by using low voltage on the vacuum switch contacts. Too rapid a change in cutoff point adjustment, with age, was mostly overcome by changing from a BZR-8 micro-switch to a BZR model. This model requires half the pressure to operate but twice the movement. This reduced the tension on the wire by one-half, and consequently the tendency to stretch over a period of time is mostly eliminated.

The use of a micro-switch with such a large differential between cutoff and reset points made it necessary to incorporate a relay to cut out part of the series resistance when the interlock operates. This would increase the current to bring the reset pressure point within a few microns of the cutoff pressure point (Fig. 1). A time delay relay maintains the current for about 45 sec after the switch has closed the interlock circuit. The time delay prevents recycling near the reset point.

In order to make it possible to adjust and check the cutoff point of a switch without letting a leak into the system, an external calibrated resistance box was incorporated (photograph Vacuum 171). Cutting in more series resistance has the same effect as admitting a leak (Fig. 1).

A decade box with 10-ohm steps was made to plug directly into the front of the interlock panel (photograph Vacuum 171). The insertion of the box "buggers out" the circuit so that the switch can be tripped by means of the resistance box without affecting the system on which it is installed. A curve on the face of the decade box indicates the tap number at which the tap switch should be set to produce cutoff with the existing forepressure. The switch would then cut off at 150 μ pressure with the decade box removed. The adjustment is done as follows: Read forepressure in system at the time, plug decade box into panel, set tap switch at tap corresponding to forepressure. Wait 5 sec for switch to operate. If it does not trip, the cutoff point is too high. Turn the screwdriver adjustment rheostat (R2) on the front panel to the left until it trips; return the tap switch to zero and wait about 1 min or until you hear the time delay relay in the panel operate.

For a different cutoff point than 150 μ, it would be necessary to replace the curve on the decade box with a different one.

There may be some advantage in placing the switch on the other side of the booster pump instead of the forevac side. It may remain cleaner there.

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*Contract No. W-7405-ENG-48.

The reset point of the switch is adjusted upon installation of a new switch or a different switch. It is done when the system is not being used and the pressure in the pumps can be increased to 150 μ by means of a leak valve. Adjust the cutoff point by means of the screwdriver adjustment on the front of the panel until it cuts off at 150 μ when the pressure is raised to that value. Then adjust the tap on the voltage divider resistor (R1) to the point where the switch will reset at about 140 μ. If the reset and cutoff points are too close together, the system will recycle about once a minute.

The assembly and adjustment of the hot-wire quartz push rod is done as follows: Assemble the terminals, mica washers, and spring washer without the quartz rod, as shown on subassembly Drawing N 7172A (photograph Vacuum 172). Place the quartz rod in the guide tube to determine the correct length. The rod can be clipped off on the end and finished by grinding to length by holding it perpendicular to a carborundum oil stone, grinding it flat on the end.

Loosen the adjusting nut on the push rod guide tube, slipping a small wedge of something under the assembly of terminals, mica washers, and spring washer to keep the parts together and in contact with the nut. Loosen enough to get the tungsten wire over the notch of the rod, then carefully tighten the nut with a pair of long-nose pliers (removing the wedge) until the rod has pushed the micro-switch pin far enough for it to click off the switch. This should occur near the limit of the downward travel of the nut, so the spring washer is under enough tension to hold the whole assembly tight.

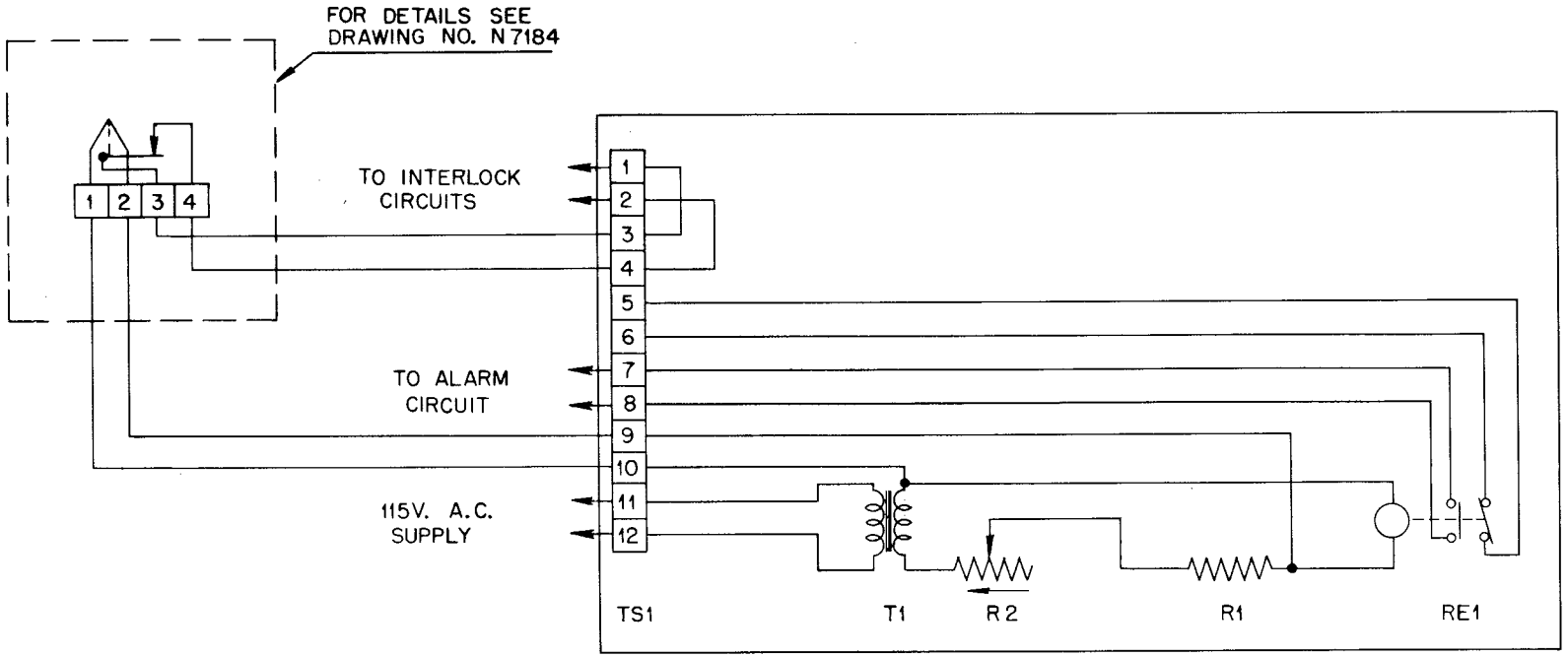
Adjust the nut to the point where it requires a moderately firm pull outward on the rod to click the switch. This will be a very rough adjustment of the range. If this adjustment point does not occur at a point where the spring washer is firmly holding the whole assembly, remove the rod and grind a little more off. If it is too tight, another, slightly longer rod will have to be put in.

The switch will have to be adjusted by putting it on a vacuum system with a leak so the pressure can be adjusted between approximately 10 and 250 μ and read with a McLeod gauge.

The switch should be adjusted to cut off at about 150 μ, with the external adjusting rheostat at about half value. The low external adjustment will then produce a cutoff point around 100 μ and the high adjustment around 200 μ, the range varying with individual micro-switches.

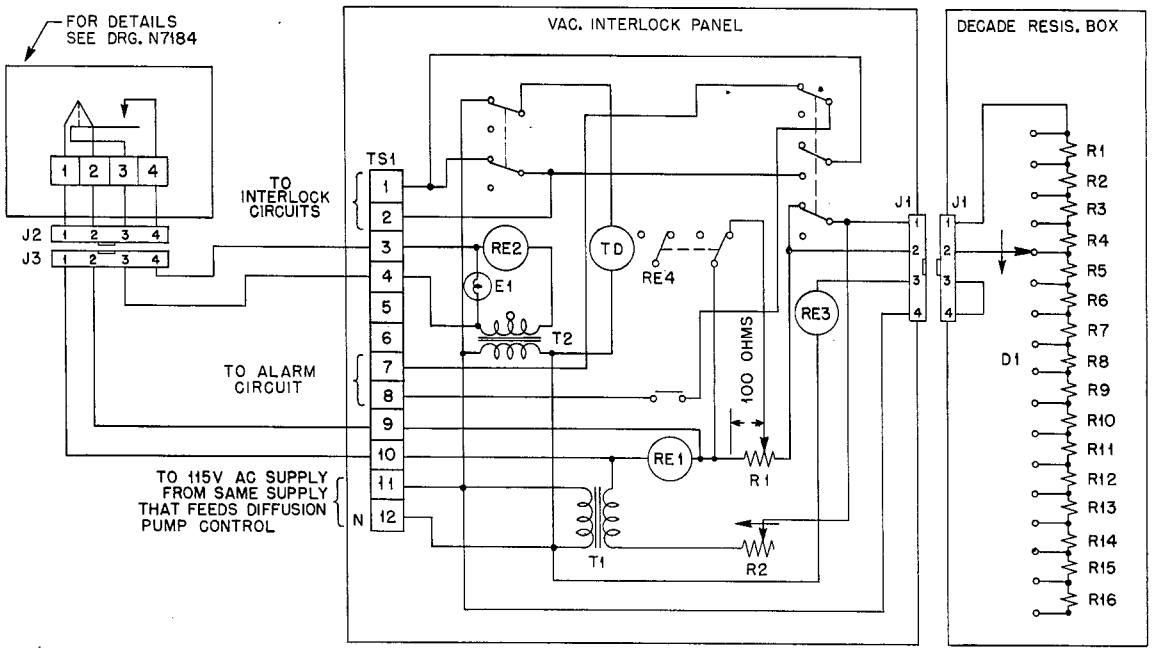
The adjusting will be "cut and try." Turn the nut of the switch a very small fraction of a turn at a time, as this is a very sensitive adjustment. Turning the nut clockwise will decrease the cutoff point, and loosening it will increase the cutoff point. The switch will have to be let down to air each time the internal adjustment is changed.

On further investigation, it was found that it is best to leave the wire in its annealed condition, rather than to recrystallize it by heating in a Bunsen flame, as was suggested in Vacuum Spec. No. 15.



DESIG.	APPARATUS
R1	OHMITE NO. 0568C-50W.-400 OHM RESISTOR
R2	IRC-PR-25-25W.-50 OHM RHEOSTAT
RE1	ADVANCE NO.1501-115V. A.C. RELAY
T1	SOLA NO. 3000-30 VA-115V CONSTANT VOLTAGE TRANSFORMER
TS1	CURTIS 12 PT. FEEDTHRU TERMINAL STRIP

Schematic Drawing 1W 1332—Hot-wire vacuum interlocking panel. For assembly see Drawing 1W 1344.



CHANGE LETTER	DATE	CHANGE
A	8-30-44	SEE REC. PT 1V5172
B	9-26-44	SEE REC PT 1V5172A
C	10-13-44	SEE REC PT 1V5172B
D	10-31-44	SEE REC PT 1V5172C
E	12-21-44	SEE REC PT 1V5172D

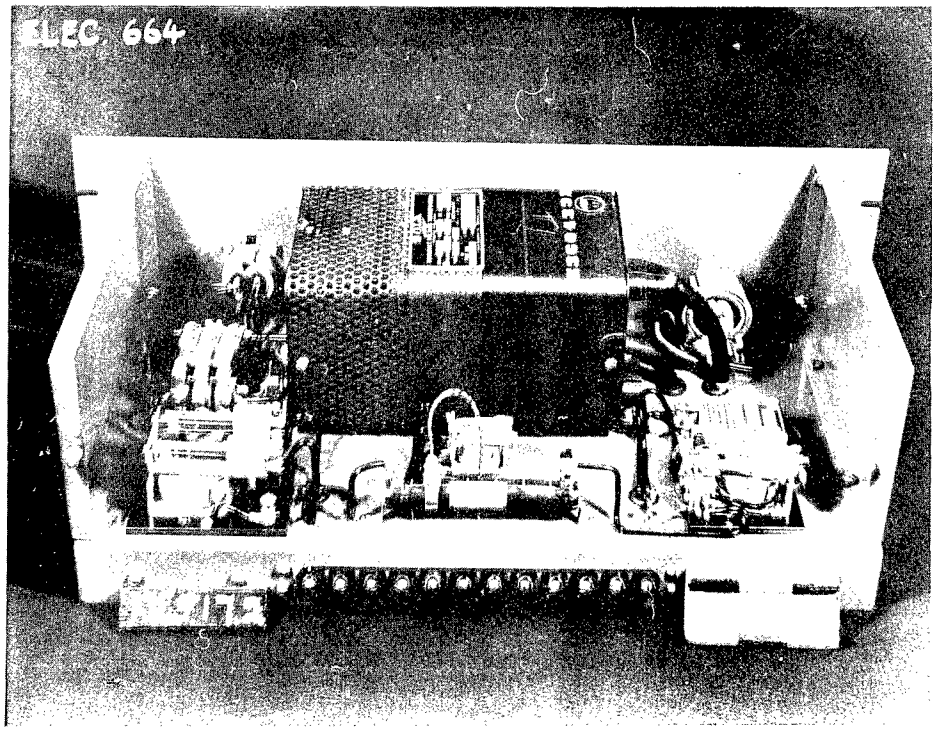
DESIG.	VAC. INTERLOCK PANEL APPARATUS
E 1	DRAKE NO. 30-S AMBER PILOT ASSEM.
	G.E. NO. 1487 12V LAMP
J 1	CANNON NO. P4-13 4 POLE PANEL RECEP.
R 1	OHMITE NO. 0568C 400 OHM 50W ADJ. RES.
R 2	1 R.C. PR 25 100 OHM 25W POT. (SCREW DRIVER SLOT)
RE 1	ADVANCE 1501 SPST 115V AC RELAY
RE 2	ADVANCE 104 BM DPDT 6V AC RELAY
RE 3	ADVANCE 979B TPDT 115V AC RELAY
RE 4	ADVANCE 304B DPDT TD 115V AC RELAY (SET 1 MIN.)
T 1	SOLA NO. 3000 30VA 115V TRANSF.
T 2	THOR. NO. T19F80 115/6.3V CT 1A TRANSF.
TS1	CURTIS 12 PT. FEED-THRU TERM. STRIP

DESIG.	DECADE RESIS. BOX APPARATUS
D 1	MAL. NO. 31117 J 1C17P SH. TAP SW.
J 1	CANNON NO. P4-18 4 POLE PANEL PLUG (MODIFIED-PRONG 4 SHORTENED)
R 1	SPECIAL 50 OHM NON-IND. RES.
R2-16	SPECIAL 10 OHM NON-IND. RES.
J 2	AMPHENOL 04M CABLE CONN.
J 3	AMPHENOL 04F CABLE CONN.

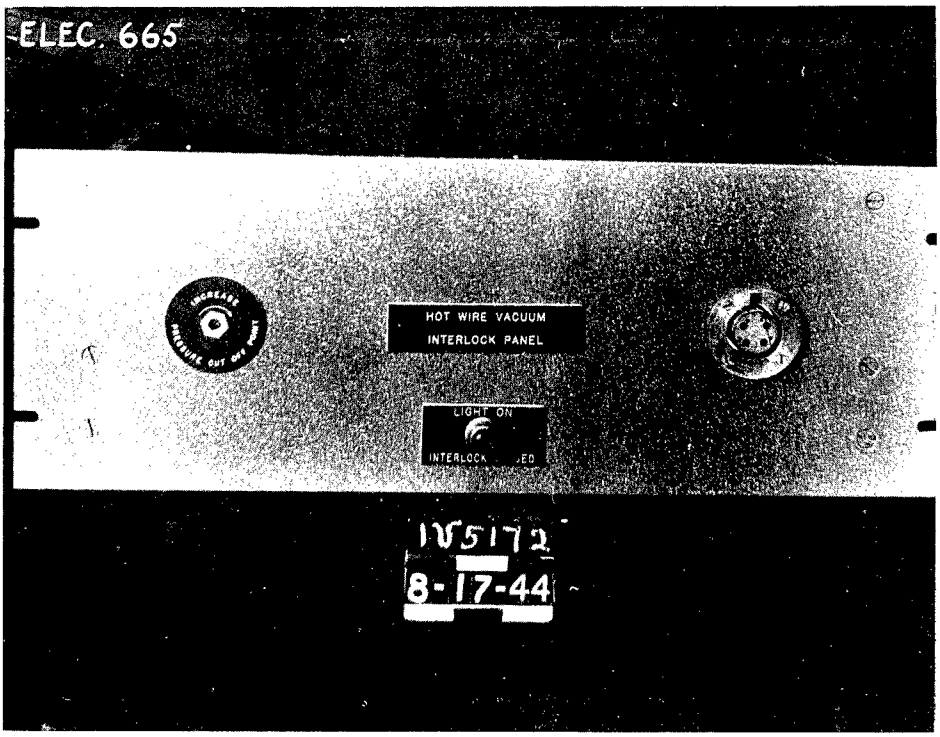
NOTE — R1-16 NON-IND. WOUND WITH MANGANIN WIRE FOR MAX. CURRENT 250 MA. - BY METER DEPT.

DE-BUGGED HOT WIRE INTERLOCK PANEL
FOR ASSEMBLY, SEE DWG 1V5184 AND 1V5272

Schematic Drawing 1V 5172E — Improved hot-wire interlock panel.



Electric 664



Electric 665

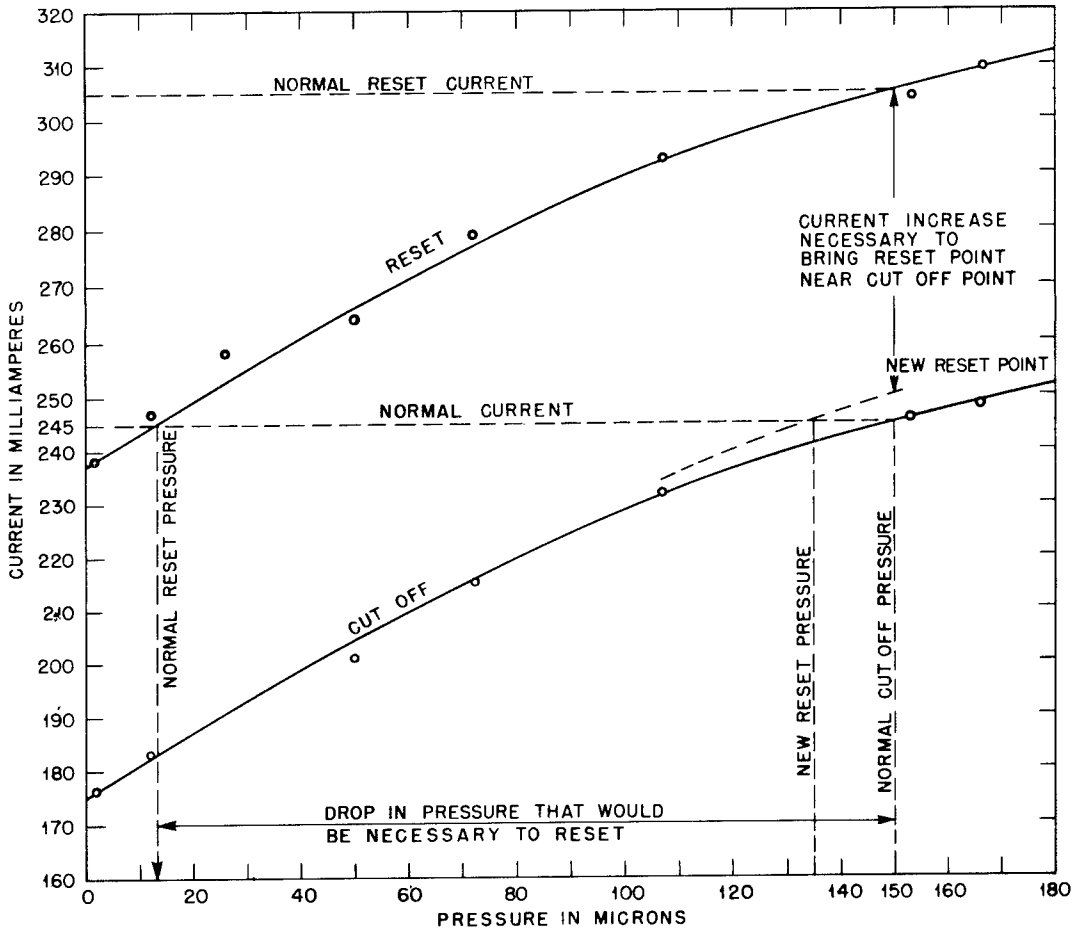
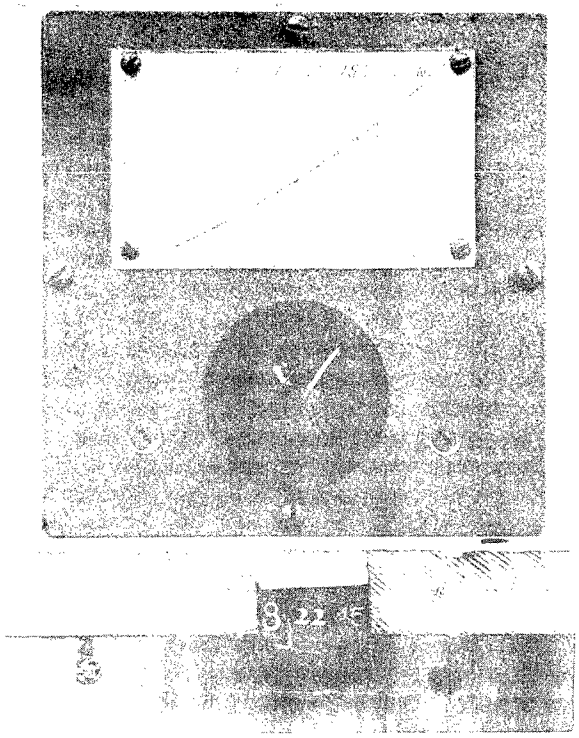
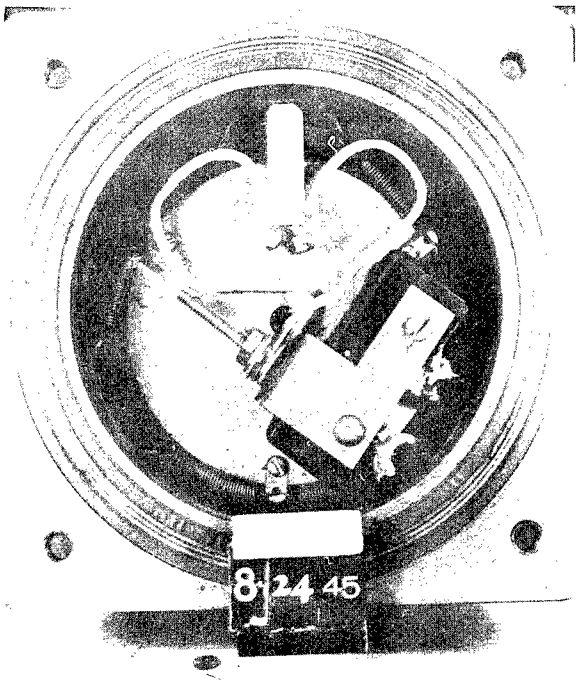


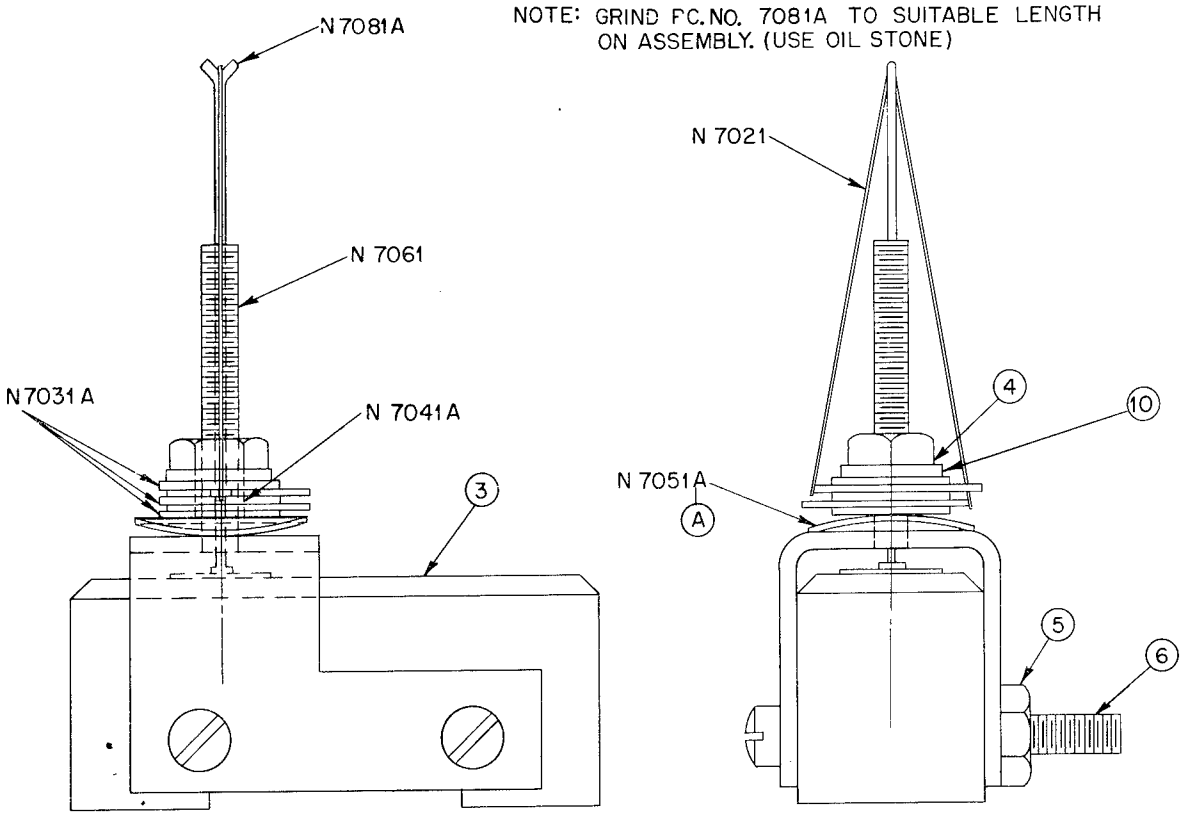
Fig. 1—Cutoff-reset differential, 114-volt a-c supply.



Vacuum 171



Vacuum 172



PART NO.	NO. REQ	DESCRIPTION
N 7021	1	HOT WIRE TERMINAL ASSEMBLY
N 7031A	3	WASHER (MICA)
N 7041A	1	HARD RUBBER INSULATOR
N 7051A	1	ADJUSTABLE WASHER
N 7061	1	HOT WIRE AND SWITCH SUPPORT ASSEMBLY
N 7081A	1	PUSH ROD
ITEM NO.3	1	PIN PLUNGER MICRO SWITCH TYPE (BZ-R8)
" NO.4	1	BRASS NUT 5-40
" NO.6	2	6-32 BRASS FIL. HEAD MACHINE SCREW L-1 1/4
" NO.5	2	BRASS NUT 6-32
" NO.10	1	5/16 O D 1/8 I D BRASS WASHER

(A)

CHANGE LETTER	DATE	CHANGE
A	6-2-44	WASHER ADDED (10) SIZE OF WASHER CHANGED

Drawing N 7172A

END OF DOCUMENT